MOMENTUM

Assisting heart patients with workout intensity

MFA Degree Thesis Report
Oskar Wembe, Advanced Product Design
Umeå Institute of Design 2015
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Patients that have suffered from a heart attack, has a condition called coronary artery disease. This condition is partly inherited, but lifestyle choices such as diet, smoking and exercise account for as much as 80% of the disease progression and outcome. Today a great majority of patients with coronary artery disease choose not to participate in an exercise-based rehabilitation programme after an event, even though exercise has shown to reduce mortality rates by more than 25%. What if we could encourage patients with coronary artery disease to engage in exercise-based rehabilitation treatment outside a hospital environment?
INTRODUCTION
Submaximal cykeltest

BORG-SKALA

0 Ingen alls
0.5 Mycket, mycket svag (knapp nästa)
1 Mycket svag
2 Svag
3 Mättlig
4 Ganska stark
5 Stark
6 Stort stark
7 Stort stark (nästa till maximal)
8 Stort stark (nästa till maximal)
9 Stort stark (nästa till maximal)
10 Maximal
BACKGROUND

‘Not only was he exhausted both physically and mentally from the hospital visit, but now he also completely had to rethink his current situation.’

CHOOSING THE TOPIC

When a friend of the family had a heart attack (myocardial infarction/ischemic heart condition), it came as quite a surprise to everyone around. Luckily he survived and quite soon he was able to go back to his old life and work.

When I later interviewed him when in search of a degree topic, I was very amazed by how grateful he was for getting a second chance. Not only was he exhausted both physically and mentally from the hospital visit, but now he also completely had to rethink his current situation; workload, dietary habits and the level of exercise.

When I asked about his determination to change he said that it was a real eye-opener to experience something like a heart attack. Even though everyday was a struggle, he had gained a better perspective on what really mattered for him. He knew that if he wanted to change the outcome of his life, he was the only one who could do it.

Inspired by this story I wanted to understand what mechanisms that drives us to change behavior, what makes us aware of our condition, and most importantly; what motivate us to change?

Through interviews and user studies I want to understand the boundaries and adversities that is surrounding the recovery process, and hopefully find additional solutions to current cardiac care.
The degree project is the final project during the two year MFA education in Advanced Product Design at Umeå Institute of Design. The Project stretched over a 20 week period, whereas the last 3 weeks were dedication for final presentation, examination and exhibition.

The project was carried out on an individual basis, with the goal of finding a product solution to a topic chosen by the students themselves. Internal and external tutoring was provided by the school, but all external collaboration and tutoring - from both companies and organisations - was arranged by the students themselves.

The exam was consisting of two parts - one oral and visual presentation, held at Umeå Institute of Design, and one written report which is the document that you are holding in your hand.

Cardiovascular diseases (CVD) are the group of physical disorders related to the heart, arteries and blood vessels in our body. It is by far the number one cause of death among the adult population in the world, and the risk increases with age.

In 2008 CVD represented about 30% of the global deaths, killing 17.3 million people. By 2030 this number is expected to rise to 23.3 million. CVD are mainly deriving from bad habits; an unhealthy diet, stress, lack of sleep, physical inactivity, tobacco and overuse of alcohol. These lifestyle choices will eventually show up as “intermediate risk factors” such as raised blood glucose, raised blood pressure, raised blood lipids, overweight and obesity.

In Sweden alone the annual cost for CVD is surpassing 60 billion SEK.

The problem today is to educate the patients into maintaining a healthy lifestyle. This is the reason why healthcare is looking into alternative ways: “There is very strong evidence that prevention pays off in terms of reduced morbidity and reduced cost.”

Anders Dahlquist, member of the Medical Association’s Central Board, writes in an
article from 2014 about cardiac preventive care.

It has been proven that patients who are identified early on in primary care (‘primary prevention’), i.e. at the general practitioner, could be given inexpensive treatment and advice on how to reverse bad lifestyle choices. Patients that are identified after e.g. a stroke or infarction, are instead identified at specialist care, e.g. cardiologist. This is known as “secondary prevention”. These patients has a huge chance of a relapse and in worst case death. One of the biggest challenges for the swedish healthcare system today is still to follow-up on patients with a cardiac history. “The biggest flaw in cardiac care is still secondary prevention, i.e. how healthcare works to minimize the risk of another heart attack”\(^2\), states the Swedish Heart- and Lung foundation in their summary from 2013.

So why aren't the healthcare system more successful with preventing CVD? First of all we have the social, economical and cultural factors - “the cause of the cause” - which can determine how well a patient can cope with changing their life. This may include denominators such as heritage, stress and poverty. Secondly, interventions from the healthcare system are very costly and resource demanding. Other contributing factors are believed to be lack of patient contact in favor of administrative work, lack of continuity within primary care as well as a lack of collaboration between primary and specialist care.\(^3\)

Fortunately, CVD can many times be prevented by the patient. As an example, lifestyle choices and behavioural factors are accounting for about 80% of the outcome of coronary artery disease which is the most common type of CVD\(^1\). The problem is that, without awareness and control, patients easily lose control and end up in a downwards spiral.

In this project I therefore wanted to investigate if we could break this cycle, and instead encourage patients diagnosed with a CVD to behavioral changes.
The initial research was done together with Västerbotten Läns Landsting and Norrland University Hospital (NUS). The main collaborator was the center for heart related diseases (Hjärntcentrum) as well as the center for behavioral medicine (Beteendemedicin), who provided me with interviewees and feedback during the initial research phase. Interviewees was also found outside Norrland University hospital to be able to document the process (a clinical environment is restricted due to patient privacy).

A User-Centered Design-approach, including “Method” (research, analysis and insights), “Ideation” (user tests, validation and ideas) and “Final result” (visualizations and final concept), were applied to the project.

The initial phase included interviews and studies of previous or current cardiac patients, as well as care providers such as doctors, nurses and physiotherapists. Psychological- and behavioral aspects was also investigated to acknowledge some of the findings.

Collected data was later analyzed and transformed into insights which worked as a foundation for potential ideas. These ideas were conceptualised through visualisations and physical representations, and evaluated together with patients, medical staff, tutors and other qualified participants.
The hope is to combine existing behavioral and rehabilitative methods in an attempt to complement and possibly extend prevention within cardiac care.

**TUTORING**

Umeå Institute of Design will provide internal tutoring from the APD programme director Thomas Degn, as well as external tutoring from Anders Smith, a Copenhagen-based designer with a background in medical design.

*Ulf Näslund, Operations Manager* at Västerbottens Läns Landsting will provide connections to staff within Hjärtcentrum.

*Marie Lidgren, Head of Department* at Hjärtcentrum will provide initial research material as well as interviewees for the research phase.

*Catrin Cras Segerbrandt, Physiotherapist* at Hjärtcentrum will provide me with feedback on the concepts and detailing as well as more detailed information about patients and users.

**PROJECT GOAL**

The project goal is to create a solution for patients with coronary artery disease, which is the most common type of cardiovascular disease. Through providing a preventative solution that is based on existing behavioral and rehabilitative methods, the hope is to bridging cardiac care with home care. *The product shall be educative and encouraging in its quest to assist the patient in their treatment.*

The potential target group are patients that are in the stage of post-diagnosis or in a recovery from a cardiac event. Other stakeholders such as doctors, nurses and family will also be included. The outcome shall be an innovative solution based on the needs of cardiac patients. It shall not replace existing methods nor be a replacement for medical staff, but rather act as a stepping stone in the recovery process. The product should fit the needs of the patient as well as the needs of the Swedish healthcare system.
1. RESEARCH
From initial brainstorm session

- Behavioral Factors
- Intermediate Risk Factors
- Diet
- High Blood Lipids
- Tobacco
- High Blood Pressure
- Overweight & Obesity
- Alcohol
- Mental Stress
- Physical Stress
Surprisingly, WWII was one of the reasons scientists discovered how the intake of fat and cholesterol affects cardiovascular diseases.

Throughout history, explorers have done cross-cultural observations from mainly Africa, Europe and Asia on how differences in dietary habits and lifestyle seemed to affect mortality rate. But the greatest achievements in the prevention of CVD should no doubt be dedicated to the 20th century and the rise of industrial society.

In 1914, a Dutch man named Cornelis de Langen arrived in East Indies to teach internal medicine. To his surprise, he noticed the absence of CVD with the local Javanese population in comparison to the Dutch colonies. De Langen was one of the first people to prove how differences in especially diet could affect cholesterol levels.

With improved medical methods, such as autopsy, clinical observations became more common and had a groundbreaking effect on the understanding of how the body worked. Whereas certain conditions such as Coronary Artery Disease (CAD), was only discovered at surgery, medical aids such as the electrocardiograph had a breakthrough in the early 1900s, and aided the doctors in the understanding and prevention of e.g. cardiac ischemia (heart failure) and myocardial infarction (heart attack). Further experimentation led to the discovery that some cardiac events such as myocardial infarction (MI) not always led to death and that the main cause - atherosclerosis (thickened artery wall) very much was something that could be reversed if certain lifestyle changes were made.

With World War II came the disruption of international markets which led to food shortage and starvation. Studies showed a dramatic decline of CVD during war years and an increase of them Post-war, leading researchers to new assumptions and proposals.

But even if researchers could make estimated guesses about cardiovascular prevention, there was a lack of evidence to support them. One of the major breakthroughs in CVD prevention history came with the “Framingham” study in 1948. The study found evidence of multiple risk factors with individuals developing CVD. The discovery was groundbreaking and has establish guidelines that are still used in preventive practice today.

The “Seven Countries” study made in 1957 showed that the lowest rate of CVD diseases was to be found in the Greek islands and Japan, whereas the highest were found in Finland and the United States. This reinforced the connection between cultural dietary- and lifestyle habits and fat intake. Jeremy Morris, one of the pioneers within CVD epidemiology, soon also proved the connection between socio-economical status and CVD mortality with the “Whitehall” study where he compared 17,530 men within the British civil service. The study for example showed evidence that physical activity had a protective effect on the body.

The ‘Framingham’ study in 1948.
Since the 1970s, more studies have made scientists interested in how not only risk factors such as cholesterol, blood pressure, diet and smoking affect us, but also the individual risk. The interest and search for genetic markers has intensified, as well as going 'beyond' clinical trials. The reason is that most CVD cases have been proven not to derive from high risk patients but from the general public - or what is defined as “normal” in the chart. Also, the gender aspect has been redefined and compared, showing that women not only have a lower risk of CVD (until a certain age), but also are different in risk, manifestation, diagnosis, treatment and, most importantly - survival of cardiac events. With better medications and newer preventive techniques, the survival rate of CVD has generally improved. But with a constantly aging population comes the increased risk of cardiovascular diseases, and with that possibly the need for a more seamless prevention.

So how will we prevent cardiovascular diseases in the future? Since CVD are increasing in almost every part of the world, a lot of possibilities haven’t been explored properly; a breakthrough in genetics research, better adherence to medication or new ways of screening and identifying high risk patients might just change the course of action. “The problem requires an exploration of novel ways to uncover solutions. Health innovations that embrace new knowledge and technology possess the potential to revolutionize the management of CVD”, as stated in the medical research paper “Health innovation in cardiovascular diseases”.

But most likely there are not one single solution to the problem. The structure of our current healthcare systems are crippling itself through putting administrative work before patient contact. This means that doctors and patients have less time to interact with each other and to gain an understanding of the bigger picture and individual needs - efficiency before continuity. “Collaboration between primary care and the open specialist care is crucial for achieving better secondary prevention. Inadequate staffing and continuity from primary care is likely a contributing factor to poor compliance rates”, writes Anders Dahlqvist.

Finding high risk patients at primary care is crucial for continuous evaluation, but knowing that one of your parents had a heart attack might just not be motivation enough to change your life; “At the individual level, for prevention of first heart attacks and strokes, individual health-care interventions need to be targeted to those at high total cardiovascular risk or those with single risk factor levels above traditional thresholds, such as hypertension and hypercholesterolemia. The former approach is more cost-effective than the latter and has the potential to substantially reduce cardiovascular events.”, argues World Health Organization. A lot can happen during a few years time and hereditary factors are just a small fraction of developing a disease. Maybe we should look towards what is best for the patient rather than staring too much at the journal; “present risk scoring translation means that in a 100 patients with a similar risk profile, 20
would develop a major cardiovascular event in ten years, 80 patients out of the 100 would not. Yet, all get targeted as high risk and receive management. In other words, preventive cardiology is today targeting everyone with a family history of cardiac events or high-blood pressure. Presenting a cost-efficient solution that is targeting the symptoms might seem reasonable, but how does this affect life quality? Vascular surgeon Per Birger Lundquist makes an interesting comment on an article on secondary prevention; “My medical colleagues do not seem to care about the whole picture; the patient’s health rather than the individual diagnosis." In the end we all have different needs, and these needs might not always be met by the preventive methods; not receiving a treatment that is tailored to your personal needs might be one of the reasons why cardiac patients are not inclined to follow the doctors advices.

THE NEED FOR SELF-PREVENTION

So is this only a flaw in our healthcare system? Partially the answer is yes. Clinics like American ‘Kaiser permanente’ with 9,2 million customers (about the same size as the Swedish population) have understood the importance of prevention, and now offer their patients screenings and examinations to their customers as a part of their care plan. The problem is that this is a very costly and resource demanding process, making it difficult to compare two very different healthcare systems. But there are undoubtedly both economical and social benefits to prevention, and especially self-prevention; in a report from 2008 it was justified that approximately 10000 swedes could avoid stroke every year if patients with high blood pressure achieved the advised goals in 80 percent of cases - all to a reduced cost of 7 billion SEK. In another Swedish study, 257 cardiac patients with high blood lipids was prescribed a home testing device to measure their cholesterol levels. After a year, 93% of the participants reported that they were still taking their medication. In normal cases, around 60% are staying on their medication after 3 months, and about 50% in 6 months. “- The results shows that if the patient, through self-testing, is getting a greater responsibility for their own treatment it increases both the understanding of the disease and the motivation to medicate as prescribed.” says professor Anders G Olsson, specialist in cardiology- and internal medicine at Stockholm Heart Center. The question remains; with a population that is constantly aging, how much more pressure can our current healthcare system deal with? Maybe it is time that we start taking more responsibility for our own health?
‘Minor check-ups, screenings and after-surgery recovery and will be done in the comfort of your own home.’

FUTURE SCENARIO

“Deep and fundamental reforms of health and social care systems will be required,” says Dr John Beard, Director of the Department of Ageing and Life Course at the WHO, about the challenges of our future healthcare.

With an aging and growing population, our system will not be able to cover the needs. Instead, minor check-ups, screenings and after-surgery recovery and will be done in the comfort of your own home. A new type of care – Preventive Homecare - will take the pressure of intensive and specialist care and also lower the costs that comes with running a hospital; around-the-clock staff and patient housing. Instead the patient will have closeness to family and friends, homecooked meals - all in a familiar surrounding. Check-ups will instead be done through consultation with your doctor through various medias. The obvious benefits beside patient care is of course less transportation and queueing - but also more time to do things that feel more important to the patient.

HOW WILL THIS WORK?

Patients are invited for a yearly check-up where the state of body and mind is evaluated. After a screening and a questioning based on lifestyle factors that could affect health over time - such as diet and smoking - a risk assessment will be done to determine current health status. To improve until next time, the patient is recommended what behaviors to change or keep. If changes are made the patient can move up, and down, the insurance ladder - not depending on your current status, but rather in the time you put in taking care of yourself. This way, the healthcare system would provide a more tailored care with necessary recommendations and tools for improving the full health aspect - instead of just treating the symptoms with medication as we do today. Disregarding lifestyle factors will be more and more difficult as we grow older and our medical bills are piling up. It is time that we provide suggestions to how this possible future might look like.
Coronary artery disease (or Atherosclerotic heart disease) is a long term build-up from fat in the vessels and artery walls, mainly due to bad lifestyle choices. (See figure 1) The progression is normally made over decades, making the disease hard to notice. Coronary heart diseases are a group of diseases causing e.g. Ischemic stroke and Ischemic heart disease (myocardial infarction/heart attack) which are the most common types of cardiovascular diseases.

An infarction can either be silent, with fewer symptoms, or acute and more painful; when cracks are formed in the artery walls due to inflammation, the thrombocytes (blood cells that prevent bleeding) are reacting through coagulation, forming a blood clot that could prevent blood - and therefore oxygen - from passing through the vein to parts of the heart tissue. Both stages needs immediate attention, but the latter has the advantage of being easier to reverse if the patient survives. The lack of oxygen to organ tissue is known as Ischemia. Since dead tissue can not be recreated, the heart is replacing it with scar tissue. The patient can also suffer from temporary pain due to angina pectoris, which is a temporary ischemia. It is normally classified as stable or unstable depending on how long-lasting it is.

If having e.g. an infarction which has been extremely severe, or a patient has had multiple infarctions over time, this will result in weaker scar tissue which might result in heart failure, arrythmia, or in worst case; a pacemaker. This can sometimes be very difficult to recover from, some patient will never be the same again, whereas it is important to discover the intermediate risk factors - high blood pressure (hypertension), high cholesterol levels (dyslipidemia), diabetes as well as suffering from overweight and obesity - as early as possible. The mortality rate for myocardial infarctions are twice as high for men as for women. Below the age of 60, the risk is four times higher for men as for women, but despite this, infarction is still the leading cause of death with both genders. Normally the patient goes directly to ICU for a so called balloon dilation or Percutan Coronar Intervention (PCI), when a plastic hose is used to dilate the vessel and release the clot. After this intervention, a small basket - a stent - (see figure 2) is put into the vessel, preventing further clots. The recovery process until the heart is fully healed takes about 4-6 weeks. During this time many patients tend to feel physically and mentally weaker, sometimes even preventing them from engaging in the recovery.
At an age of 80 years, the average heart has pumped an average of 200 million liters of blood. For people that are living an active lifestyle this number might sometimes be even higher. Since the heart is a muscle, it needs to be exercised and challenged; think of it as the engine of the body, it keeps us going as long as being maintained properly.

But of course, sometimes there are factors in our surrounding that we can not affect. Our genetical heritage or other biological factors provides us with advantages or disadvantages that either make or break us later in life; this could be everything from developing high blood pressure to being sensitive to glucose, which in turn leads to diabetes. There are also socio-economical factors that could contribute, such as poverty or growing up in an abusive family. Even though we might take this more or less for granted in first world countries, it is still an important factor to consider for your physical and mental well-being. Other contributing factors are gender and age; men has a generally higher risk of developing CVD, and with age we become more fragile which increases the risk for complications.

But even with an underlying cause, the most common risk factors for developing CVD are the so called behavioral factors. They include having an unhealthy diet, use of tobacco or excessive amounts of alcohol, being physically inactive, and having longterm stress due to work or other situations. The underlying factors are normally showing up as intermediate risk factors. These are the first symptoms that might lead to a CVD and therefore requires continous check-up and evaluation. Nevertheless, improvements to avoid lifestyle-related CVDs such as coronary artery disease can always be made through maintaining good lifestyle habits.
Expert interviews
My initial contact in this project was with Ulf Näslund, who is the former Head of Department at Hjärtcentrum. Hjärtcentrum is the name for the Department that is covering all heart and cardiovascular-related activities, spanning from research to surgery. When I meet with him, he explains why Hjärtcentrum is in the forefront of research about heart diseases; “Our goal is to have the worlds best primary prevention”, Näslund says, and it is obvious that he is very proud of the preventive work that is accomplished at Norrland University Hospital (NUS). Today he is partly retired from his old job, and shares his time between the Dept. of Public Health and Clinical Medicine as a Senior lecturer and working with NUS on a longterm project which he holds particularly close to heart: VIP - Västerbotten Intervention Programme.\(^\text{13}\)

In the 1980s the mortality rates were at their highest in Sweden, and especially in the county of Västerbotten. As a counterreaction the community founded Västerbotten Intervention Programme, which had the goal of decreasing the morbidity levels and prevent mortality of both diabetes and CVD. Based on an earlier Intervention programme in Swedish Norsjö, the strategy was to intergrate an examination into the ordinary routines of primary care. People at the age of 40, 50 and 60 are then invited to undergo systematic medical screening and individual counseling on lifestyle and habits. In 2010 an estimated 115,000 examinations had taken place, with an annual participation of about 6,500-7,000 people. The annual participation rate has been pending between 48-67%, with a remarkably steady rate of 66-67% since 2005. The data collected is plasma glucose, blood lipids, blood pressure, body mass index (BMI), level of physical activity, tobacco and alcohol habits. The patient also estimates their own health. The data is shown through ‘star-profiles’. The blood samples taken during the examinations are currently stored at Umeå University Medical Biobank for future research purposes.\(^\text{14}\)

Näslund, who were one of the people who was early involved in the project, says that between 2013-2015 there is also another step of the study called Visualization of Asymptomatic Atherosclerotic Disease for Optimum Cardiovascular Prevention or VIPVIZA. Here the patients are further evaluated and scanned for arterial plaque through the carotid artery and possible

“Our goal is to have the world’s best primary prevention”

-Ulf Näslund
also looking at thinning of the artery walls. 50% of the patients are then shown the results while 50% are not. This is to evaluate how awareness about your condition is affecting and possibly empowering the participants, making them more benign to change their behavior. After almost 30 years of collecting data, there is a comprehensive database for collaborative and cross-disciplinary use both nationally and internationally. People that are targeted as risk patients during the examination is forwarded to the doctors for medical examination on a preventive basis. But there are still questions that remain unanswered; how do we evaluate such a vast amount of data? Is the data relevant in a few years time? What about patients that are on the verge of being risk patients, or the 30% that do not want to participate in the study? How do we target these people?

MARIE LIDGREN

My first interview at Norrland University Hospital was with Marie Lidgren, who is the Head of Cardiovascular Treatment & Physiotherapy. During our first session we generally discussed the work at NUS. Lidgren has a great insight in both the preventive and rehabilitative work, and we initially discussed the idea with the Västerbotten Intervention Programme; “The idea is that if you give a more visual response to the patient, then the tendency to maybe make lifestyle changes might increase.” Further on we discussed the difference between having a heart condition and a cardiovascular disease, the first are including many different diseases such as arrhythmias and congenital condition (i.e. biological factors), whereas the latter is more connected to behavioral factors. “The patients that we treat here have a coronary artery disease, and they get very strict changes to follow, we talk a lot about the major risk factors; blood pressure, blood lipids and diet, physical activity.” Lidgren is also pointing out that beside the VIP-study, they are not working on a preventive basis in primary care yet, but rather treating the symptoms as they show up. Sometimes the treatment means an adaption to totally different habits in combination with lifelong medication and a big part of the problem is to get pliability to follow the doctors recommendations. Many patients are therefore resignating to the inaccurate notion that the disease is something that they have inherited and any precautions they might take are therefore useless. Current preventive work is focusing on making the patient more aware of his or her situation; “The best part would be if the patient comes up with the answer, cause that would mean that there is an awareness.” For some patients, a diagnosis in one way or another, can come quite as a shock even if the symptoms still can be reversed. As a help on the way to changing habits, the healthcare system is offering a visit to the physiotherapist for dietary and lifestyle advices, as well as for measuring your optimal pulse rate. At NUS they are also offering hospital-based group exercise for patients that are not used to physical activity; “There are a few patients who have zero previous experience, saying ‘I know I should but what should I do? Where should I start?’ here we offer them to participate in group exercises for 3-5 months. Right now we have two exercise groups, one easier level and a more difficult level, and also water gymnastics.” For a patient with a diagnosis, you are likely to be on one or several medications. If you also
had a cardiac event or surgery, both your physical and mental levels will be significantly lower. This is the reason why the exercise groups are not using pulse rate as their measurement for effort. “We are using the Borg rating scale-RPE (Rate of Perceived Exertion) ... it is an evaluation scale where you evaluate both ... breathing rate and effort.” This way every patient can adapt to their physical level without being fixated with what your pulse is, but instead focusing on the feeling. It is also important to understand that healthcare has limited resources as well as a limited responsibility for the patient. The thought is to give the patient the best prevention could in other words seem less connected to a motivational trigger than secondary prevention, or as Lidgren put it; “I can imagine that a “wake-up call” is something that you more likely experience after diagnosis.” Since behavioral factors are very different, the difficulties in changing them vary, for some it is physical barriers and for others it is purely mental; “There are people who think it’s really really difficult to eat medications on a regular basis since that is something they have never done before. This is maybe more on a psychological level; admitting that ‘I’m sick’ or something like that.” One other problem is also that some patients either do not enjoy group activites, the activity doesn’t fit them, or they live too far away to be able to participate.

During my second session with Lidgren, we talked about the motivational aspect and the pros and cons between primary and secondary prevention; “If we talk about primary prevention, then it is maybe more about the health aspect if you can call it that.” Primary behavioral changes are through smart phone apps. Trial studies have been performed by medical companies to determine how behavior is affected when the patient have to keep track of their own medication routines, but so far there has been no official publication. At the same, Lidgren argues for the importance of having a physical contact, especially in the initial stage of the process. When the doctors don’t have time for a lot of questions, the nurses are playing a very important role. At the same time she admits that there might just be an opportunity for some type of extensional solution; “I think that you need to be able to have that first visit, in real life, face-to-face so to speak, I don’t think a product can replace that. But on the other hand, after you have received this basic information about your disease, “I think that you need to be able to have that first visit ... then maybe you could have support in a different way.”

-Marie Lidgren
what should I change, what are the risks, then it is a different thing, then maybe you could have support in a different way."\(^1\)\(^5\)

This took us back to the previous session where we discussed the importance of having a more continuous recovery, a interim period perhaps, where you gradually have to take more responsibility of your own recovery; “You take over and become more independent and get to have more responsibility, so it is more of a smooth transition.”\(^1\)\(^5\)

Lidgren sees no problem with activating the patients as early as possible, but of course it all depends on the patients physical and mental abilities. Sometimes it becomes to much of a project to change everything at once, then it’s more convenient to start from a different end; if the patient had to change one thing right away, what would that be, and how motivated are you to make that change? It is also important to consider what state the patient is in. What type of disease, if it can be prevented and what age and state you are in (e.g. post-surgery) is key to finding the right target group. According to Lidgren it is not a bad idea to minimize the target group to coronary artery disease, rather the opposite; “It is not a bad idea to limit yourself to a certain disease. Even if there might be differences, they are more homogeneous as a group which is maybe making it less fuzzy.”

The last questions to Lidgren was was concerning socio-economical factors; besides the importance of having a good social network around you the economical aspect became apparent for the first time; We also have patients were we have an economical aspect; they want as little medication as possible, they want to participate in as few exams as possible simply because it costs money. Even if we basically have free healthcare, paying a visit to the specialist is around 300 SEK, to meet one of our nurses or physiotherapists is 100 SEK”, maybe it doesn’t sound that much, and after a few visits you have reached the high-cost limit, but some patients still think that; ‘I have to get there, I have to take the bus or similar … they’re doubting for that reason.”\(^1\)\(^5\)

ELIN ÅBERG

_Beteendemedicin_ is a part of the Centre for Occupational- and Behavioral Medicine. The Umeå team, consisting of a psychologist, a nutritionist, a physiotherapist and a medical secretary, are offering group sessions for those who have a risk for either developing, or relapsing back to, lifestyle-related diseases such as obesity, diabetes type 2 or certain cardiovascular diseases such as coronary artery disease. Normally they have been sent on remittance from their doctor or nutritionist, or through a health screening at work, but also through participating in VHU (Västerbottens Hälsovårdundersökningar) - the examination done for the VIP-study. The one-year treatment is initiated with a one week _intensive treatment_ where start values are checked - blood pressure, blood lipids, blood glucose, waist and weight - as well as doing an endurance cycling test. When I asked about the attitude from a someone with just risk factors in relation to someone who for example had a cardiac event, Åberg told me that motivation is sometimes hard to pinpoint; “If you’ve had an infarction, then you might become frightened thinking ‘I do not want to die, I do not want this to happen again’. But it could just as well be that you have been at an examination where you are told that ‘if you continue in this direction you might suffer...
from cardiovascular diseases’, which in turn would get you motivated.”

The following task is to set personal goals. During the first six months the group meets half a day ever other week to work with different themes. The second half of the year there are fewer and fewer sessions. Three main subjects are on the agenda; exercise, diet and handling stress. The subjects are seamlessly tied together; after workout they are cooking together and after the meal they have a discussion about what drives their eating habits; such as social and emotional factors - or ‘compulsatory eating’. “It is important that our guidelines are fairly easy to live by, it’s not a bootcamp, it is a normalization programme.”

When I am asking her what motivates people to change, she says that there are a few things that are key; knowledge about what to do, insights and understanding to yourself and what you need to change, training those skills over and over again, and finally to count on that a relapse will happen. Many times it is unavoidable, so how can the patients instead plan for longterm change? The personal goals are divided into milestones which makes incremental changes easier. “When it comes to fitness you are never really done, it is a perishable state. It is the same with these habits, you are sort of never ‘done’ with them, but that also mean that you can’t really fail either?” Åberg says. Normally it is not a single problem that results in an infarction, rather a chain of events. But it is also important to let the participants find the motivation themselves; “If your only goal is to lose 20 kg, or if your doctor tells you that you to change your habits, then you have only this external motivation. We need to find that inner motivation; what do I gain from this? What do I want to do and feel?” Åberg tells me that it is important to find what triggers the behavior, and then what the strategies are to deal with that behavior. Finally it is important to be able to go back to what motivated you in the first place and the reason why you wanted to change. When I ask her what is most difficult to change, she says that changing your diet is difficult since it is has such a central place in our lives. Breaking a bad habit, such as smoking, is close second. Physical activity is generally the best activity to start with, since all you really have to do is increase your physical level. Moving is triggering our reward system through a chemical substance known as endorphines. Endorphines gives us a feeling

“When it comes to fitness you are never really done, it is a perishable state. It is the same with these habits, you are sort of never ‘done’ with them, but that also mean that you can’t really fail either?”

- Elin Åberg
of satisfaction which in turn could have a snowball effect on other behavior; "Since physical activity is often easier to change, mainly through moving more, it might be one of those things creates a chain reaction with the other behaviors." Other ways to deal with bad habits is to stress down and get into a daily routine with enough recovery time and sleep. Being distracted by our 24/7 society is affecting us more than we think, this is especially true for people who own a smartphone - to be reachable at all times. “Accepting that challenge to actually turn off the phone on a regular basis. I don’t need to be updated on Facebook ... that you can set those boundaries that ‘now it is night, now I turn off. One should not be reachable in this way” Åberg points out.

Many times the routine is broken when returning to your old life; having a stressful job, being a single parent of two, having a non-supportive family or spouse - it can either make or break your new habits. Another important factor is economy - some people just can not afford to be on a sick leave. Even if there is a roof on how much you pay it is still a significant cost; “We have patients from every social class, but many of them are people who may not have the best financial situation. We must take into account that they can not afford to buy the expensive training cards. We have to find something else that works in between.”

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- Elin Åberg
Krister Lindmark is the current Head of Cardiology at Norrland University Hospital. The reason I interviewed him was to understand the steps that a patient with a coronary artery disease go through. Lindmark insist of showing me a brief presentation on his computer. When he asks me what I think the risk of having a heart attack for a healthy person who is 45 years old is, I have no clue what to answer. It can’t be that much? “30%?”, I say. “60% for men, and 56% for women - if you smoke or have high-blood pressure it is of course more,” he replies. The reason, he explains, is due to atherosclerosis - clogging of the arteries; “Many see coronary artery diseases as a natural way of aging, it is not a natural way of aging.”

One of the biggest problems, Lindmark tells me, is the fact that it is a silent condition, you feel really well since the process of clogging takes decades. “This is a process that will take decades, that’s why you can be 20 years old and be smoking every day, play video games all night and eat pizza morning, noon, evening without getting a heart attack.” This is also why intervening early in someone’s life makes little sense. Even though the risk factors are there, it is almost impossible to motivate someone to live a healthy lifestyle if they do not have the will. Nonetheless, Lindmark sighs and asks himself if maybe we should work earlier with prevention; “You could ask yourself, when we look at lifetime risk, perhaps we should be intervening much earlier in the treatment? Especially with blood lipids that we know has a big influence.” Lindmark mentions that a lot can be done, especially if the process of atherosclerosis hasn’t gone too far; “The mystery of cardiovascular diseases is basically solved, we know what it is about, we know what it depends on, and we know how to prevent it.” The difficulties of preventing CVDs in an early stage is also the reason why I am mainly focusing on patients in the secondary preventive stage. These patients have a very clear incentive; if you want to live longer - this might just be the last chance to make changes.

“Many see coronary artery disease as a natural way of aging, it is not a natural way of aging”

-Krister Lindmark
Katrin Cras Segerbrandt was the last expert that I talked to during the project. She is a physiotherapist at Norrland University Hospital and also very interested in new ideas and solutions. When I introduced myself and told her about the project, she was thrilled to help, and I got a lot of good insights during the interview. My first questions was regarding why patients avoid hospital-based group exercise. One of the first things she told me was that patients have various reasons for not joining - but fear and anxiety are among the most common. “What actually happens every now and then is that a patient have an infarction during physical activity.”

Here, she says, there could be an opportunity for a different type of solution. She is especially interested in keeping contact with those people that join the heart school, but later drop out because they don’t want to join the hospital-based group exercise; “a simple and good way to be able to keep in touch with them.”

After discussing the hospital-based group exercise, we continue on the topic of fear and anxiety. Cras Segerbrandt says that she is more for knowledge and encouragement, but that scare tactics actually could talk about the importance on having social support around you, which the patients for example have at the hospital-based group exercises. But Cras Segerbrandt also admits that it is not always that easy; some people don’t join because they love group exercise but because they get things done. And for motivation, this could be crucial; “A lot of people who attend my groups they say I’m not a person who enjoy group exercise really, I don’t attend because it is a group I attend because you tell me what I have to do.” She also tells me that it is sometimes not just reasonable to even form a group at all. In a city where you normally have a good flow of patients, hospital based recovery makes sense. But in a smaller community it is not always that easy; “It is clear that if you live in Lycksele or if you live in Storuman/Tärnaby (rural areas) there will be no group. It’s like four people who need to work out in different ways.”

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Patient interviews
Richard got an infarction last spring when he was at home. He had taken a long walk and was just about to sit down in the sofa and watch some football, when he felt an unpleasant feeling. The pain quickly grew and soon felt like someone stabbing him in the chest. That’s when he told his wife to call for an ambulance. When I asked Richard how he got the infarction, he says it did not derive from bad habits; “It can of course depend on bad lifestyle habits and such, but for me a lot of the problems are genetical.” This is a common misunderstanding from cardiac patients, which could perhaps be related to ignorance, shame of being lazy or simply because the healthcare system is not informative enough. Soon he mentions that he knew he wasn’t taking care of himself the last six months before “It was stressful, I worked 60-70 hours a week, I had really bad eating habits; sometimes McDonalds 2-3 times a week”. When he is thinking back he realises that he also could have moved more; “Even though I have quite an active life with hunting and the dog and so on it is was not enough.” He also says that it is easy to get caught up in everyday life, before he prioritized work, but after the event he has realized what really matters to him; “I want a long and healthy life, I don’t want to be a vegetable.” He says that besides motivation, family and the hospital staff has helped him a lot; “I have changed doctors a lot, I really don’t have any confidence for that, but I have my cardiac nurse who has been there the whole time.” He also says the key is to make incremental steps, like having fruit and vegetables at home and try to incorporate everyday activities into your daily life; “My office is at the fourth floor, and I have as a rule to always walk these stairs in the morning, this is stuff that I have never done before and I am trying to find these everyday opportunities to exercise.” He also says it is important to make incremental steps, otherwise it is easy to loose motivation; “Do what is simple. It should feel natural, it shouldn’t be like earlier when I have been running, where I have been like, *sigh* ‘I have to run faster and faster.’ Which means that after a week when I have reached my pain threshold, ‘now it isn’t funny anymore’, and then you stop. You shouldn’t build those barriers, but rather find ways that make it simple and fun.”
“I like these gadgets where you can see that you are improving.”

-Richard, about his love for gadgets and new technology
PERSONAL INTERVIEW

Lars, 63
Silent infarction

HAD SEVERAL INFarCtIONS

Lars is working at the University hospital in Umeå. He had a quiet arrhythmia a little more than a year ago, that started when he was on a weekend trip. Since the pain was not imminent, he tried to be rational about the symptoms, thinking that it is probably not that serious. But when returning to work on the following Monday, he was just exhausted. Therefore he called up a friend and a colleague to ask for advice. He immediately was advised to seek medical attention at the hospital. He got examined and was hospitalized for PCI (Percutan Coronary Intervention) or ballon dilation the same evening. After the surgery he got medication and had about a month of rest before he relatively quickly went back to work. After some weeks when he was walking up the stairs he just blacked out. Luckily, a surgeon found him and did a quick examination. He was again hospitalized and treated the same evening, this time with cardiovascular surgery. At the same time he caught an infection and was put on antibiotics. During the recovery process he felt very weak and could just walk around the block. Another colleague then recommended him to switch medication, whereas he immediately felt better. “I guess I was a little bit privileged since I work here,” he says. After recovering from the infection it went better for Lars. He now has the right type of medication and has started to join the hospital based exercise regime that is offered; “It has been a year soon, now in May ... as long as there is space you don’t have to leave, but when new people arrive to the group then those who have been around the longest have to go.” Lars admits that he has been lucky to have the professional support around him, but also explains that it is important to find the inner motivation and get going as quickly as possible; “If you don’t do anything about it, like going to a workout session or something, then it is easy to fall into old tracks, you get lazy. You have to take the initiative yourself.” Lars also had the opportunity to participate in a medicational study where he tried an app that reminded him of taking his medication, measure diet and physical activity. He really liked the longterm overview that he got.
“They had a phone app ... there was the possibility to register how many minutes you were exercising ... I thought that was really great.”

-Lars, about an application he got from a medical company
Gunnar, 69
Severe acute myocardial infarction

HAVE HAD A DIFFICULTIES TO RECOVER

Gunnar had a myocardial infarction quite some years ago now, but he is still not really back to his old self. Before he used to go running and skiing, but after the infarction things changed; “I told myself that I needed to start very gently.” It all started with a stressful job. Gunnar had a high position at work, and one day when being at his summerhouse the infarction struck. During surgery the doctors noticed that something was wrong with one of the valves, and he had to start taking medications to get rid of the problem. The process after surgery went very slow; “If you had asked me then I would’ve said that I need to be on sick leave at least a year.” Gunnar was very displeased with how the recovery period went by. The information he was did not really encourage him in his recovery; “The material I have received is a bit light-hearted, a bit like the brochures you get from political parties before the election.” It was especially difficult to be on a totally different physical level as before. Gunnar has a history of low blood pressure, which affected his medication and made him exhausted just walking uphill or in stairs; “I didn’t manage to do anything, I took very short walks before I dared go to the neighbor which was only 150 m away.” Still to this day he is taking long walks everyday, but now the medication is at least right. He used a blood pressure measuring unit in the beginning to be able to have something to discuss with his doctor about what medication to use. This did not become easier when seeing different doctors from time to time; “What could be done better is the continuity with the doctors, I know I had at least 25 doctors and it was probably up in somewhere between 25-30 doctors.” Gunnar is very grateful for the support of friends and family, especially one nurse that recommended him what doctor to go to with certain issues.
“There was no extensive mapping of my habits, other than asking about my diet and finding my target heart rate."

-Gunnar, about the following examination
Additional research
Strategies to prevent heart disease
- Don’t smoke/use tobacco
- Exercise 30 minutes a day
- Gain a healthy weight
- Follow a healthy diet
- Sleep well
- Maintain healthy lifestyle
B.J. Fogg - creator and director at Stanford University's yearly Mobile Health conference
THE FOGG BEHAVIOR MODEL

BJ Fogg is a psychologist and PhD at Stanford University. Besides being the creator of Stanford University's yearly Mobile Health conference, he is also the founder of Stanford Persuasive Technology Lab, where he is running research projects on captology - the study of computers as persuasive technologies. Fogg has also created the Fogg behavior model, a guiding tool for designers to identify why a user is not performing to the target behavior. According to the Fogg behavior model, behavioral change occurs when the three factors of motivation, ability and trigger occur at the same time. With motivation, Fogg means that there must be a core motivator such as pleasure/pain, hope/fear and social acceptance/rejection in order for someone to change. The ability to then change then depends on simplicity factors such as time, money, physical effort, brain cycles, social deviance and non-routine. This is a good example of why the team at Beteendemedicine wants their participants to create long-term habits that the patients can live with (“normalization programme”), instead of quick fixes. In the end the changes need to be sustainable and to come from the patients themselves - not from the wishes of the medical staff. Finally we have the Trigger; the facilitator, spark or signal that gives you that push to change. In exercise-based rehabilitation at the hospital, the physiotherapist, nurse and doctor is the main facilitator. Also the group dynamics can work as that little extra that makes things happen. But outside a hospital environment, things are most likely different.

In behavioral economics, reframing - incremental changes in how a question is posed - has shown to have a large impact on how decisions are made. When confronted with a choice, people tend to stick with something that others have chosen. Therefore, engaging patients in exercise-based rehabilitation could also rather be a matter of showing what others did to succeed instead of explaining why you should do it. Family, friends and colleagues can therefore also work as the facilitator or spark that triggers change, but at the same time they can also be the obstacle that prevents change from occurring. Could perhaps an assistant tool persuade someone to behavioral change just as captology suggests?
EXERCISE AS A PREVENTIVE METHOD

FYSS - ‘PHYSICAL ACTIVITY IN THE PREVENTION AND TREATMENT OF DISEASE’

FYSS or Physical Activity in the Prevention and Treatment of Disease, is a product that sprung from the purpose of increasing the national awareness for physical activity. FYSS is working as an instrument for different type of educations as well as for professions dealing with physical activity. The hope is to be able to educate patients on the benefits of increased physical activity in a preventive state, and/or as a treatment of disease.39 For patients with coronary artery disease there is an even greater need for preventive measures, especially at an old age. In FYSS recommended training methods can be found, including intensity, RPE, frequency and duration. The most important method is central circulation aerobic training, distance or interval. For patients with coronary artery disease, this is recommended to do 3-5 times/week with an intensity of 50-80% of VO₂ max (maximal oxygen uptake), with a duration of 40-60 minutes/session.

Resistance training, such as lifting weights and similar, is recommended to do 2-3 times/week with 1-3 sets of 10-15 RM (repetition maximum). Both training methods should correspond with 12-16 on the Borg-scale-RPE, which is “somewhat strenous” to “very strenous”. The recommended measurements to do are “heart rate monitoring” of some sorts, as well as using an accelerometer to accurately measure sedentary as well as active time which the simpler stepcounter can not do. Since patients that have had an infarction are on medication, this becomes extra important; “Certain drugs, such as beta-2 stimulators, which are common for asthma, and beta blockers, which are common for cardiovascular problems, affect systems (such as heart rate) in the body, which in turn can affect the assessment of aerobic fitness and physical activity. For these individuals, movement sensors (step-counters and accelerometers) are recommended ahead of heart rate monitoring. In aerobic fitness tests, perceived exertion should always be used in combination with heart rate”.40 To be able to see improvement, the patient normally returns every 6 months to do a new submaximal test, measuring their maximal oxygen uptake.26 The recommended guidelines for FYSS will work as a foundation for the final concept, both in terms of what to measure and how to measure it.
During my visit at Norrland University and the interview with physiotherapist Cras Segerbrandt, I had the opportunity to see one of the hospital gym halls where patients do their rehabilitation. At the gym hall patients can engage in both strength and cardio, either on their own or together in a larger group. All patients who are in need of physical rehabilitation are welcome to join, regardless of age, but a majority of the participants are elderly people that have a medical history of cardiovascular diseases. At the gym hall there are also a large amount of exercise bikes where submaximal tests are performed in coordination with both physiotherapists and a doctor. If the patient have just been diagnosed, an initial test is taken to set what level of physical activity that should be recommended. It could for example be that the patient experienced chest pain or a complication during surgery - in that case a lower level of physical activity is recommended. Normally, blood pressure as well as ECG is taken during the test, and the patient have to answer questions regarding medication, perceived exertion rate (Borg-scale), if experiencing any pain or injuries and finally if there has been an over-all improvement since last time. 

During our discussions, Cras Segerbrandt came to the conclusion that the existing submaximal tests are a little bit unfair: “It is not really fair that we are testing them on a bike, then we ask the exercise something else (like running or swimming) and then we test them on the bike again.” One of the wishes is to maybe adapt the submaximal tests so you could be tested more accurately depending on what type of exercise you are engaging in. Today this is not really feasible due to the fact that it is a matter of cost for the healthcare system to have several machines - bikes are something they already have at NUS. One idea is to extend the tests test for walking, running and swimming since these ways of exercising are very cost effective for both patient and hospital; ”The reason why we promote walking, running, biking and swimming is because it is basically free, meaning no extra cost for the patient.” Submaximal tests for e.g. walking and running does already exist at other facilities. Maybe the submaximal tests could be used as a platform for calibrating workouts made outside a hospital environment as well?
PATIENTS ARE IGNORING THE FACTS

“There are significant benefits to be made by providing better information to give people the tools to change their lifestyle.”

-Joep Perk

PATIENTS DO NOT UNDERSTAND THE UNDERLYING FACTORS TO CVD

In a Swedish national survey (SPICI) done at 29 hospitals and answered by 1073 patients, a majority - 57 % - believed that they were healthy after undergoing so called PCI-surgery (Percutaneous Coronary Intervention). “There is a clear lack of understanding of the underlying factors to why people become ill, there is a lack of information from the care system which also results in a lack of effect on lifestyle changes. “There are significant benefits to be made by providing better information to give people the tools to change their lifestyle so that the atherosclerotic process and cardiovascular disease can be slowed down.”

-Joep Perk, head of the research team that ran the study.

The latest year there has been a downgoing spiral when it comes to patients joining hospital-based group exercise. Perk and his colleagues therefore wanted to understand why people are dropping out: “It is surprising how patients seem to bury their heads in the sand when it comes to their disease. We see, for example, that more than half of the patients that were surveyed do not want to join the exercise groups after heart attack.”

The reasons are likely to be many, but there is clearly miscommunication somewhere down the line; more than 1/3 of the participants wished they had gotten more information about how to avoid and prevent future events, even though as many as 71 % stated that they had gotten some type of advice from healthcare staff.

At the same time it is obvious that patients do not have the relevant knowledge about the process of atherosclerosis or CVDs in general: About 50 % believed that heritage is the biggest factor for the disease. Close second came stress with 45 % and third age with 41 %. Though national guidelines also state that information should, if possible, be handed out to the patient while in company of a relative or family member, only 7/10 patients stated that was the case. “I think the message to the patients needs to be much more clear. Medical care can treat the condition with pills and catheters, but most (of the changes) the patients have to do themselves.”

It is obvious that many patients do not understand the seriousness of CVDs. A majority is treating it as a temporary illness rather than a chronic state that is caused by lifestyle.
WHY LOCATION DICTATES RECOVERY

How do we give patients the opportunity of having the same access no matter where they live?

A STEP TOWARDS A MORE INDIVIDUALISED PREVENTIVE CARE?

Geographical location can be one of the most important factors for a successful rehabilitation. Living in a large city close to a hospital or rehabilitation centre therefore rapidly increases your chances of getting relevant care. A hospital generates more patients and an activity group could more easily be formed, while in a small rural community the number of patients, the individual needs largely dictates what type of care that is possible - and many times it is none; only about 40 % of patients with coronary artery disease receive treatment from a physiotherapist.

Physical activity has shown to reduce the mortality rate for patients diagnosed with coronary artery disease by more than 25 %, and national guidelines clearly recommends physical activity as a part of the treatment after having an event. This becomes especially important for cardiac patients, since many of them are leaving the hospital with a ‘fear’ of movement - kinesiophobia. “We know that exercise-based rehabilitation reduces both the mortality and has a positive psychological impact. To develop targeted measures for the rehabilitation of patients with an exaggerated fear of movement is therefore extremely important,” says Maria Bäck, researcher and PhD at Göteborgs Universitet. But how will we find patients with kinesiophobia, if a majority of patients don’t participate in the exercise-based rehabilitation treatment at all?

A group that is investigating this are the research team behind an Irish study called “Pathway” (Physical Activity Towards Health), who wants to understand why people fall away from the structured exercise regime when leaving the hospital; “When people who are doing rehabilitation after a heart attack leave the hospital programme they are encouraged to exercise in a community setting. But only about 10 % do this, and then half of those stop going, for a variety of reasons: it may be too far for them to travel, or maybe they don’t want to exercise in a large group.”, says dr Kieran Moran, who is Head of the University hospital and part of the research team. It is especially important to find the patients that are motivated to make changes in their life. Could a solution that is more adapted to individual recovery perhaps open up an opportunity to target these patients?
FACTORS FOR A SUCCESSFUL RECOVERY

According to a Swedish study there are six needs for having a successful rehabilitation from a myocardial infarction.

The first category is called “Self-Centered Perspective” and is referring to the patients ability to take care of themselves and their body - both mentally through e.g. reducing stress, lower your demands and accepting yourself but also physically through working out regularly and eating a healthy diet. The cardiac event makes the patient realize that he or she needs to prioritize him/herself. One of the biggest challenges that the patients faced was the fact that the heart attack made them unable to continue in the same pace as before.25

The “Existential perspective” is fairly similar to the self-centered perspective with the difference that you instead have been startled from the cardiac event. The patients felt grateful for having survived the infarction and for getting a second chance in life, thus appreciating family, friends and colleagues a lot more than before. At the same time, many of the patients felt a fear that their heart would not physically make it during exercise and rehabilitation.25

“Social support” means the encouragement that the patient gets from family and friends, but also from strangers around you in your everyday life. This includes having support from work without feeling the pressure from a boss and/or colleagues. Taking on a heavy workload early on after an incident creates stress and the risk of having another heart attack.25
Professional support is extremely important during rehabilitation, and it refers to the relationship between patient and medical staff. It has shown that patients are more confident in nurses, something that has been confirmed by the Swedish Nurse Association (2008). This is likely because nurses have a higher level of patient contact - their main objective is to “help the individual to a good health”. Doctors, on the other hand, who have more administrative tasks, many times fall short with the patient, especially when it comes to giving enough information as well as taking their situation seriously.\textsuperscript{25}

Participating in a Rehabilitation programme has shown to increase the level of motivation with patients. This includes being handed the relevant information, as well as being offered to participate in organised rehabilitation and exercise. At the same time, many patients have a divided view concerning group activity; some people find it encouraging while others prefer home-based rehabilitation. In many cases proximity to either hospital or rehabilitation center is imminent to be able to join a group. Some patients even disliked group activity so much that if special home-based care did not exist they would not have participated in the rehabilitation process.\textsuperscript{25}

How you perceive your surrounding greatly affects the possibilities of recovery. This is why Environment - where you live and work - have a particularly big impact on how a patient deal with lifestyle changes. For example, if the patient lives close to a gym or a park, it is easier to perform physical activity, and not having access to healthy food and peace and quiet while eating could easily result in demotivation.\textsuperscript{25}
Patient Journeys
Lives; in countryside village
Status; married
Family; wife and 2 children
Work; Economist, IT-department
Interest; sailing, golf, hunting
Barriers; educational, mental

physical state after infarction
motivation towards lifestyle
experience of physical activity
social support
professional support

Cardiac heritage
Bad lifestyle habits
Lack of routines
Stressful at work

Acute infarction

Pre-event
Event/treatment
Motivation towards lifestyle changes

Experience of physical activity

Social support

Professional support

Physical Barriers

Mental Barriers

Educational Barriers

Post-event

Rehabilitation

Bad continuity with doctors

Got level of exertion, but no tool to check it

Lost motivation due to work

Declines hospital-based exercise, does not fit him
Lives; in the city centre  
Status; married  
Family; wife and children  
Work; administrative work  
Interest; meet friends, be in nature  
Barriers; physical, educational
Motivation towards lifestyle changes

Experience of physical activity

Social support

Professional support

**Physical Barriers**

**Educational Barriers**

**Mental Barriers**

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- Post-event
- Rehabilitation

**Physical Barriers**

- Tired from medication

**Educational Barriers**

- 3-5 month limit

**Mental Barriers**

- App provided by medical company is limited in time
**Lives; on the Swedish west coast**
**Status;** married
**Family;** wife and 3 children
**Work;** retired
**Interest;** former runner and skier
**Barriers;** educational, physical, mental

**Cardiac heritage**
**Low blood pressure**
**Work + stress**

**Severe acute infarction**

**Event/treatment**

**physical state after infarction**
**motivation towards lifestyle**
**experience of physical act**
**social support**
**professional support**
Post-event

- Weak after surgery
- "Light-hearted" information
- Got level of exertion, but no tool to check it

Rehabilitation

- Medication affect energy-levels
- Bad continuity with doctors
- Blood pressure affects exercise
- Declines hospital-based exercise, needs own pace
- Difficult to get started with exercise
PATIENT NEEDS

BETTER CONTINUITY WITH DOCTORS

ROUTINE

work & stress management

tailored information (e.g. exercise, diet, sleep, smoking, alcohol)

POST-SURGERY ADVICE

complications & risk assessment (e.g. fear of movement)

INFORMATION ABOUT MEDICATION AND SIDE-EFFECTS

KEEP UP MOTIVATION FOR EXERCISE

REACHING AND KEEPING EXERTION LEVEL
Initial research shows that there are *unavoidable risk factors* for coronary artery diseases, such as heritage, age and gender. Even under good conditions, these are factors that we can not do anything about, but for coronary artery diseases, unavoidable factors only stand for about 20% of the risk.

The other 80% are *avoidable risk factors*, these are lifestyle-related factors such as smoking, stress, bad diet, and a lack of physical activity. These factors can largely be affected with the right lifestyle choices.

Both the unavoidable and the avoidable risk factors can also lead to *intermediate risk factors*, such as high blood lipids, high blood pressure and obesity, which in turn could have a huge effect on the outcome; even if the patient have lived a healthy lifestyle, there are never any guarantees for avoiding cardiovascular diseases. However, the chances improve rapidly if good lifestyle choices are made.

**TARGET GROUP** Since the process of atherosclerosis takes decades, it is difficult to incentivise behavioral change at a younger age, even though that is normally where the process starts. The target group is therefore patients post-infarction - *secondary prevention*. The motivation for change is more obvious for people that have had an event than for patients in the primary preventive stage. However, the final solution would preferably be accessible to a larger audience.

**BENEFITS WITH EXERCISE** Regular sleeping habits, exercise, eating at regular times and taking time to stress down after a hard days work is crucial for our physical and mental well-being. But bad lifestyle habits are mainly caused by the lack of these routines. Starting a habit is usually easier than breaking one, which is why quitting smoking or changing your diet is generally more difficult than starting to exercise; through engaging in physical activity, the patient is more likely to create a chain reaction to other behavioral changes; exercise releases dopamine, which both triggers the reward system and have positive effects on energy levels, mood and sleep.

**CURRENT PROBLEM** Besides that the patients have to be motivated, the key to recovery is normally to participate in an exercise-based rehabilitation programme. But the participation rate for group rehabilitation at hospitals has declined in the latest years. Today a great majority of patients with coronary artery disease choose not to participate in an exercise-based rehabilitation programme after an event, even though exercise has shown to reduce mortality rates by more than 25%. The main causes are believed to be miscommunication about the underlying causes of coronary artery disease, as well as not having close access to a hospital or rehabilitation centre. Also, some patients simply do not enjoy group activities, or they can not fit it into their daily schedule. But today there are *no other options* besides group rehabilitation at hospitals or centres. What if we could adapt the current exercising regime to fit the patient, instead of the other way around?

**OPPORTUNITY** Before infarction patients engage in physical acitivity, a submaximal test is done to find the right exertion level. At the same time it is important to keep a certain intensity in the workout to raise the pulse. What if we could create a tool to help them keep the exercises to the right level of exertion?
GOALS

- ENCOURAGE PATIENTS WITH CORONARY ARTERY DISEASE TO ENGAGE IN EXERCISE-BASED REHABILITATION TREATMENT OUTSIDE A HOSPITAL ENVIRONMENT
- FOCUS ON THE PATIENTS THAT HAVE HAD A MYOCARDIAL INFARCTION (SECONDARY PREVENTIVE STAGE)
- CREATE A TOOL TO HELP THEM KEEP UP THE INTENSITY AND HAVE THE RIGHT LEVEL OF EXERTION

WISHES

- the solution shall when enabled;
- EMPOWER BEHAVIORAL CHANGES
- TAILOR EXERCISE TO THE NEEDS OF THE PATIENT
- INVOLVE AND EDUCATE SURROUNDING (PRIMARY PREVENTIVE STAGE)
2. IDEATION
You have probably at some point started tapping your foot or started to nod your head to that new song on the radio. Also, you might have noticed that the body’s internal clock have an ability to catch up and reset to the circadian rhythm, even though you are in a different part of the world. This is called ‘Entrainment’ and is “the process by which independent rhythmical systems interact with each other”32, as the musical researcher Martin Clayton explains it in his paper ‘What is Entrainment? Definitions and applications in musical research’. So is Entrainment only about musical rhythm then? Well, not quite so, many different systems in our world can interact and affect each other. Clayton tries to dissect the word to something more comprehensible; “Entrainment is not a single phenomenon that occurs only in human musical behaviour: it is an abstraction describing a process common to many different phenomena occurring at different scales of time and space, in both biological and mechanical systems.”32 Clayton talks about different types of Entrainment - from two clocks mutually influencing each other (symmetrical entrainment) to the sun rising and setting (asymmetrical entrainment). However, from a rehabilitation point of view the most interesting types of Entrainment are those that affect human behaviour. In exercise, elite athletes such as rowers and cross country skiers tend to synchronize their breathing to their limb movements to get a better flow. The observance of entrainment in exercise have led science to the conclusion that pacing to a beat, and especially musical beats, can have a huge impact on your workout; “during repetitive, endurance-type activities, self-selected, motivational and stimulative music has been shown to enhance affect, reduce ratings of perceived exertion, improve energy efficiency and lead to increased work output.”33 Four components has shown to contribute to motivational qualities; musicality, cultural impact, association and the most important one - rhythm response, which is referring to the musical rhythm and “tempo” of the music as measured in Beats Per Minute (BPM).33 Just as a certain tempo of music can make us energised or calm, the same way could a beat generated by haptic feedback potentially support us to keep a certain pace during exercise. Already studies on tactile feedback during exercise have shown that vibration feedback significantly increased stepping rate on a “haptic step climber”.34 There are already several products on the market such as Durr, Doppel and Soundbrenner Pulse that are already using haptic feedback as tactile cues. Florian Simmendinger, founder of Soundbrenner Pulse, highlights of the benefits with haptic feedback; “With a vibrational metronome, the musician can literally feel the beat and play along naturally. It is the way that teachers often teach music to their students as kids ... by tapping the beat onto the wrist or hand of the child who is learning to play ... This form is also way less intrusive than the audible metronome, which produces an annoying clicking sound.”35 The idea is to use haptic feedback in the same way for patients have suffered from a myocardial infarction, that needs help to get motivated and to keep up the pace during exercise. Pacing is a natural way to keep up intensity and to find your target heart rate without hitting a high barrier, while at the same time being an inexpensive option to training equipment or gym cards. Furthermore, the physiotherapist and doctor can help motivated patients stay active and evaluate the level of exertion and longterm performance.
EXISTING PRODUCTS USING ENTRAINMENT

'Durr' - haptic feedback watch

'Doppel' - wearable stress relief

Soundbrenner 'Pulse' - wearable metronome for musicians
Experience prototyping
The next step in the process was to validate the idea with using haptic feedback pacing through building a mock device from simple electronics. The idea was to use the device during several short trial runs to better understand possible benefits and flaws, as well as setting the haptic feedback level right. This was the first out of two sessions, whereas the second session had to be validated in a similar fashion with other users. The prototype was built from a small Trinket-board, a 9V battery and a vibration motor that was all soldered together and put in a protective package with the dimensions 60x25x25. A single vibration pulse was programmed into Arduino to match the target heart rate of 170 BPM (beats per minute). Different placements were considered and tested both before and during the run. The final four placements that was decided for was the ankle, the wrist, the upper arm and the chest. The haptic feedback device was also put close to the chinbone, but was soon disregarded due to giving a very amplified and unpleasant feeling. Music that is also around 130-140 in pace is also high in tempo, which doesn't make it optimal for every type of exercise. The other placements were chosen due to previous experiences of wearable technology. The results varied, but it was quite clear that leg placement was not preferred when running or walking, since the vibrations disappeared into the ground during impact. While for example upper arm became somewhat numb and chest made it unpleasant (the rib cage amplified the vibration) The lower part of the arm as well as on the wrist amplified the vibration to some extent.
The feedback session I had was over Skype with user Richard. His biggest painpoint was the fact that he had a hard time motivating himself to really get going with the exercises he was recommended. "I have so to say misplaced the whole thing with motivational factors and to really get started with the training as well".

Richard is also using several types of medication, which is affecting him on many levels; beta blocking medication makes his pulse drop, and he also feels very tired. Richard is wishing for a way to more accurately link medication to his routines, since it happens that he forgets to take it which in turns affects his mood and energy level, especially during workouts. "I've missed taking my medication ... If you had linked it to this dispenser or that I would receive a calendar reminder in the phone." But besides missing out on medication, he is neither able to accurately measure his pulse during workout. During the discussion he says that pacing is something that he could definitely use in his everyday life: "When I am out doing power walking, then I will not reach the target heart rate that I have received from my physiotherapist. But if I jog or run at a normal pace, then it will be too high."

PATIENT FEEDBACK

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A second trial session was arranged with a small group of physically active students, to confirm previous insights and also gain new ones. This time, the device was mounted on a watch, where it would hopefully sit tighter on the wrist through the use of a rubber strap. The plastic casing of the watch helped to amplify the vibrations, something that was a slight problem during the first test.

The pace was then updated from a single pulse beat to an animation of several pulses ranging from a 100 to 130 BPM, gradually increasing and decreasing during a 10 minute session. Out of the five users, all expressed some kind of emotion, both positive and negative, towards the haptic feedback pulse: “The intervals are quite fast”\(^46\), one said. Another one stated “It connects with like (my brain)... if I move my hand superfast, I walk superfast.”\(^46\) Over all the results were positive, and the users thought that the pace helped them to keep a certain intensity: “it is like a mini sergeant, but on my hand.”\(^46\) One even expressed a level of encouragement towards increasing their pace during the workout: “In fact it makes me want to run actually.”\(^46\) When talking to the users, we also discussed smaller improvements: If you are accurate (in terms of intensity and pace) maybe pulse could fade out?

These adjustments would be important in a longer perspective, but for the project as a whole, the second session most importantly showed that there is definitely potential in empowering a workout routine through haptic feedback.

USABILITY TEST - SECOND TRIAL

The second haptic feedback device.
Physiotherapist Catrin Cras Segerbrandt also gave me her view on my ideas and the device. She is convinced that it is best to focus on the people that are truly motivated but can not join for various reasons: “There are the ones who have far to travel ... those we could maybe offer something different to; ‘How would you feel about getting one of these tools?’; because they haven’t really refused our help, they just said that it is not practical.” She is not worried that technology would exclude certain age-groups or people who normally do not like gadgets: “It might actually be that you embrace technology that you see some benefit with,” she says. When I am showing her the prototype, she says tells me that many patients say they are doing their workout, but it is hardly ever enough to keep up the heart rate. She thinks the solution could possibly be used by all kinds of cardiac patients. This could help them to have a more structured exercise regime similar to the programme at the hospitals, no matter if it is aerob (oxygen-consuming) exercise, such as running or swimming, or resistance training, such as lifting weights. “This can tell you that it’s not just to walk, you have to do it in a certain pace.”
IDEATION ON CONCEPT DIRECTION

REMOVABLE BRACELETS
NON-REMOVABLE BRACELETS

ADAPTABLE BRACELET

PATCHES
IDEATION ON DEVICE PLACEMENT

LOWER ARM

WRIST
According to a study issued by European Journal of Social Psychology, the average time to change a behavior is 66 days. The concept of behavior change has been widely debated, but researchers agree that habits are born through repetitional association with a certain action (e.g. a particular workout).\textsuperscript{44} Even if the length of a rehabilitation varies for coronary artery patients, this trial period would be a good alternative to the rehabilitation programme, since the time span is very similar.

Making a consumer-oriented device would instantly be connected with lifestyle and making choices, but with a saturated wearable market - focusing more on improving skills than serving the people who actually would benefit from an innovative solution - this approach could have a negative impact on the final solution.\textsuperscript{45} A medical-oriented device on the other hand would suggest that the solution is treating; being a constant reminder that the patient is actually sick and should be regarded as such.

With a medical device the doctor and physiotherapist would have a connection to the patient and can more easily monitor progress and tailor it to both physical and psychological needs. The patient is in turn is relieved of some of the responsibility and can instead focus on gradually adapting to a new active lifestyle. Another benefit is the relief of constraints. When being offered to attend a rehabilitation programme, many patients decline due to having to work or not having close access to hospitals or rehabilitation centres. With an alternative solution the patient can instead choose where and when to exercise.

In the eyes of society, a medical device also has the potential to change how we perceive exercise as not only something uncomfortable, but something necessary: wearing a device that has been prescribed by your doctor would hopefully work as a bridging factor between the patient and society - it validates the disease and makes it more tangible - making the rehabilitation process more understandable for family, friends, co-workers and everyone else around.
A VISUAL REPRESENTATION OF AN INTERNAL MEDICAL STATE

Besides habitual change, awareness is one of the most important steps in the rehabilitation process\textsuperscript{16}, according to psychologist Elin Åberg. The final placement of the device was decided to the lower arm. Building on the idea of the device as a possible bridging factor between patient and society, the placement is an important visual representation of an internal medical state - making the surrounding aware of that the patient is sick. The idea is not to make the device stigmatizing, but rather to act as a constant reminder to the patient that this is serious; a last chance to make changes if you want to avoid another infarction.

Besides psychological factors, there are many physical benefits with skin attachment to the lower arm: being close to one of the main arteries it is the ideal spot for measuring e.g. pulse and oxygen saturation. A wrist-worn device has to sit very tight to measure, whereas a device worn on the skin would always give accurate readings. There are plenty of inexpensive medical adhesives and patches used for e.g. diabetes which could be changed once a week.

A skin worn device is also less likely be removed by the user than a wrist worn device. Just as with diabetes patients, the maintenance would instead be done by the doctor or physiotherapist to ensure accurate placement and a tight fit. The data can then be reviewed continuously by the medical staff, making changes once a week during a meet-up at the hospital. A device that is worn 24/7 also has the potential of detecting high-blood pressure, arrythmia or angina pectoris, acting as a safety system that could alert medical staff when the patient is out of a hospital environment.
A SEVEN DAY TRIAL OF MEDICAL ADHESIVES

Three different medical adhesives was tested for a week to verify that it was possible to maintain skin attachment even under the most extreme circumstances. The adhesives spanned from inexpensive woven rolls of fabric to more expensive and separately packaged plastic films. The products that were tested can be bought at any local Swedish pharmacy, thus making them more believable since they are already widely accepted and used.

The first test was the 3M Tegaderm polyuretan adhesive film with water repellent qualities. After just one workout session, the patch was dirty and loose. Besides giving heat rashes, it also withheld all the sweat, making it totally unusable. One patch is around 10 SEK and they lasted for approximately 3 days of usage.

The second test was Apotekets självhäftande väv, an inexpensive woven adhesive from one of the pharmacy’s own product lines. This adhesive cost 34 SEK for a 2,5 meter roll. In contrast to the polyuretan film, this adhesive felt less clinical and was also breathing better. The woven adhesive lasted for approximately five days, but was very difficult to remove since almost all of the glue was left. It also gave some rashes.

The third and last test was done with Hypafix, a woven adhesive similar to the previous one. It is an establish brand used for e.g. wearable diabetes pumps, and it lasted for 5 days during this test, due to bad placement. Hypafix is slightly more expensive but well-known for its breathability and easy removal. This adhesive therefore became the preferred choice due to comfort and hygiene.
Making the device a medical product instead of a lifestyle gadget was based on the rational fact that user experience many times beats desirability - at least from a longterm strategic perspective. Lifestyle and trend is cyclic and temporary, whereas a good experience is timeless. So is it then possible to make a medical product desirable and intuitive without focusing too much on emerging trends? Perhaps the user experience could be desirable in itself given the right circumstances? In the article “UX is 90% desirability”, designer and writer Fransisco Inchauste argues that after a certain transition point, User Experience (UX) becomes the differentiating factor: “When the level of technology in a product becomes enough for users and saturated within competitive products, the experience becomes the differentiator and continues to add value.”

In a world where we are constantly surrounded by wearable gadgets, the customer is expecting more than just a shiny surface. Many times this is the key differentiator between failure and success - there needs to be a balance between product exterior and the experience. The goal was to be like an independant organism, reflecting reassurance and comfort while at the same time being clinical - like the relationship between a host animal and a parasite. Through using a mat-white silicone base, the product is given the reliability of a medical product. The semi-transparent cover proudly expresses confidence to show of the technological interior. The device is given an bold expression through its use of mat pastel colors descretely detailed with spitlines and graphical elements.

From the article “UX is 90% desirability”
FORM LANGUAGE

Product inspiration - organism / assistant / parasite

Product feeling - comforting / reassuring / clinical
COLOR, MATERIAL & FINISH

Product expression - proud / bold / confident

Product finish - splitlines / matte pastel / semi-transparent
Concept refinement
Size from first variations slightly scaled up and changed to be able to fit all the electronical parts.

Shape inspiration; Athos Core
The CAD-model developed into two different variations that can be detached in different ways.

The different variations were sent for a second test print.

One of the two variations developed from the first CAD-modelling session.
A first test print is made to establish size and fit, as well as to test live on an adhesive patch. The printed plaster parts are dipped in glue to be more sturdy during testing.

Medical patches were laser cut and tested on the prototype before finalizing the adjustments for the CAD model and 3D-printing.

The parts are refined and technical details are added. The shapes are evaluated and tested live on the medical patch to determine cut and size.
Grip / pinching lock?
Thicker edges?
Space for measuring?
Added ridges?
Final body
Final frame piece
3. FINAL RESULT
CURRENT OFFER

1. CARDIAC EVENT
   Patient has a heart attack

2. FIRST MEETING
   Patient has a first meeting with doctor after event.

3. DECLINING GROUP REHABILITATION
   The patient declines group rehabilitation for various reasons. No other option today.

Healthcare has no more alternative if group rehabilitation is declined.
4. ALTERNATIVE OFFER

Momentum is offered as an alternative to group rehabilitation.

10 week individual rehabilitation
MOMENTUM PROCEDURE

1. CARDIAC EVENT
Patient has a heart attack

2. FIRST MEETING
Patient has a first meeting with doctor after event.

3. OFFERING MOMENTUM
Momentum is offered as an alternative to group rehabilitation.

4. PHYSIOTHERAPIST
RECORDS WORKOUT
A tailored workout session is recorded together with the physiotherapist

5. 10 WEEK REHABILITATION
Patient exercises 3-5 times a week with intensity assistance from the Momentum device.

6. WEEKLY MEETINGS WITH PHYSIOTHERAPIST
Patient has a weekly meeting with the physiotherapist to evaluate progress of rehabilitation and updated exercise routines.
“Our cardiologists often talk about a window just around when you have had the heart attack, when you have the opportunity to get a message across."

-Catrin, about an opportunity at the first meeting with the heart patient

THE MOMENTUM PROGRAMME

During the first meeting with the doctor, just after having a heart attack, the patient is often in shock - this leaves a window for convincing them to engage in lifestyle changes. The first step is to offer group-based exercise at the hospital or a nearby rehabilitation centre. But many patients experience that they do not have time to participate several times a week in the group exercises that is offered today. Often this is related to their working situation or due to the fact that they just live too far away. The result is that only 40% of patients are joining these programmes.

Momentum is a an alternative way of doing exercise-based rehabilitation based on the individual needs of the patient. It is running parallell to the exercise-based group rehabilitation, and the idea is to build exercise habit that creates a domino effect on other behavior. When joining the programme, a contract is established, and the device and smartphone application is prescribed to the patient by the doctor. The patient is borrowing the device during the whole rehabilitation period and when the 10 week programme is over, the patient simply returns the device. It is deregistered from the programme, leaving the device application unusable.

Since the device is always attached to the patients arm with a medical adhesive patch, there is a lower risk of it being unused or left in a dark corner of the home. At the end of the rehabilitation, all statistic data that has been collected is printed together with comments from the Physiotherapist. The hope is that this could work as a reference when leaving the healthcare system. It is imaginable that the printed data could later be used to guide the patient when getting their own workout equipment, or to initially instruct a personal trainer if the patient decides to start exercising in a more controlled environment.
1. AN ALTERNATIVE TO GROUP REHABILITATION

Momentum is a workout assistant that empowers the patient to build an exercise routine progressively over time.

The patient is wearing the Momentum device for a limited time of 10 weeks - a similar time span to the programmes that are offered today. These programmes are building mainly on low-cost aerob workouts such as running, swimming, biking, aerobic exercises and basic circular training - something that could be done with little or no equipment. Momentum is therefore an inexpensive alternative to, for example, a full-year membership at the gym, which is often needed for more arranged workout activities.

Maintenance of the device is done during weekly meetings with the physiotherapist. The body membrane is cleaned, the battery is charged and the patch is changed and adjusted, or moved to the other arm if wanted. At these meetings there is also an opportunity to discuss the past or upcoming weeks workout sessions: the medical staff can advices on how to improve the routine and exercises pace can be adjusted if intensity has proved to be too high or too low. New exercises can also be recorded to add versatility to the rehabilitation, as long as the patient is exercising according to the plan.

SIGNING UP FOR THE MOMENTUM DEVICE DURING THE FIRST MEETING

1. AN ALTERNATIVE TO GROUP REHABILITATION

The Momentum device is removed through 1) prying up one of the sides and 2) lifting it from the silicone frame.
After signing up for the Momentum device, the patient is recording a tailored workout session together with a Physiotherapist, by choosing from different workout routines and a range of exercises that is used in the exercise-based rehabilitation programmes. These exercises are then performed by the patient under the supervision of the Physiotherapist, who is recording workout pace and intensity through the Momentum application.

The recorded session can then be used by the patient to work out in the right intensity with the exercises that they prefer - all depending on previous workout experiences, physical level after the heart attack, as well as personal preferences.

The idea is that the patient is slowly progressing each week with feedback and updated routines in consultation with the Physiotherapist. If the exertion level is too high or too low, or an exercise is badly performed, this will be noted by the Physiotherapist who can ask questions accordingly.
During the 10 week programme, Momentum is helping the patient to build an exercise habit through various exercises. The device is supporting the patient with workout intensity in the form of haptic feedback pulses sent out by the vibration engine.

The application lets the patient choose from different pre-recorded exercises that can be changed, and uploaded to the Momentum device. These exercise can also be viewed in the application as an entity or as individual exercises, supporting the patient during the workout if necessary. When the patient wants to start the uploaded exercise, he or she simly just presses the play button on the device.

Through the application, the patient is connected to the doctor and physiotherapist that can support with workout advice, information about medical side-effects and other things that can have an impact on the exercise routine.
HOW DOES IT WORK?

Bio-impedance signal
1. MOVEMENTS ARE TURNED INTO PACE

Body movements are recorded during an initial workout session. These movements are turned into a pace through the accelerometer.

2. PACE IS GUIDING INTENSITY DURING WORKOUT

The pace is in turn translated into haptic feedback signals. These signals will guide the patient to the right level of intensity when working out at home.

3. BIOIMPEDANCE MEASURES PROGRESS

Body values such as heart- and respiratory rate are measured through bio-impedance sensors. As the heart is strengthened, values change and progress can be seen.

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Bioimpedance measures the electrical signal through skin conductance (sweat) between two points. It is known for being energy-efficient, inexpensive without compromising accuracy.
COLOR VARIATIONS
1. This is Michael, a little while ago he suffered a heart attack. In his family there is a heritage of heart problems, but the result was caused due to bad exercise habits and a lot of stress at work.

2. Two weeks after the heart attack, Michael got to see a doctor to discuss what happened and to get an overview of his current lifestyle. Michael also got the offer to join exercise-based group rehabilitation. He politely declined since it would collide with his working hours.

5. The Physiotherapist begins by changing his medical adhesive patch. While they charge the device, they are discussing the past week, and what he would like to change for the next. Michael mentions that he has been improving and would like to increase the intensity.

6. They discuss what exercises to add, and what the intensity should be. After that, Michael performs the routine while it is being recorded by the Physiotherapist through the Momentum application.
3. As an alternative to group rehabilitation, Michael was offered Momentum, a workout assistant that is based on the same principles as existing rehabilitation programmes. Momentum is worn for 10 weeks to build an exercise habit during self-rehabilitation.

4. Today, Michael has used Momentum for three weeks and he is going to see the physiotherapist to discuss his progress. So far it has been good, but he wants to improve and would therefore like to change some exercises for next week.

7. The recorded session is then saved and uploaded to the Momentum device. Michael can now use the recorded exercise for future workout sessions.

8. When Michael returns home, he immediately puts on his shoes and heads out. He is eager to try the new workout routine.
The Momentum application
A lot of people that have been in a similar situation as you choose walking because it requires no additional knowledge or preparations.
CONCLUSIONS AND
REFLECTIONS
MY THOUGHTS ABOUT THE PROJECT

Conclusions

Looking at the schedule, I believe that I accounted for the most necessary steps that I had to go through, but I also could have calculated the time frame for all the steps that I did not have as well.

Taking on a medical project can be very exhausting - especially if you do not have a clear goal from the very beginning. During my BFA Degree Thesis I did this very mistake, and the project was a growing out of proportion. For my MFA Degree Thesis, I had a much clearer objective what I wanted to achieve. Still, it is difficult to foresee the outcome when you haven’t specified a particular product that you want to work with. In my case, I believe I should perhaps have done this beforehand. But sometimes it is difficult to create something new where little has been done before. On the other hand, does it always have to be something new?

I have learned that not having a very clear timeframe, or maybe in this case, not having a very specific topic, will cause you even more work in the end which requires a different type of schedule. This could probably have been avoided if I had more knowledge about Cardiovascular diseases from the beginning.

At the same time, I believe that this is exactly what an education is all about. We are supposed to fail, not for the sake of failing, but for the sake of learning. The insights I have gained in this project required me to really step out of my comfort zone, relying on the tools I have learned. In my future career, projects will always be more specific, hence I will have knowledge that is invaluable. Perhaps I could have challenged myself a lot less, but I believe that a lot of the work that designers do requires an amount of uncertainty.
REFLECTIONS ON THE FINAL SOLUTION

With a User-Centered design approach and an open mind I entered uncharted medical territory with this project. As a Product Designer, I have truly been challenged: how could I contribute to a field that is mainly driven by Behavioral Science and human interaction? Is it at all possible to motivate people through technology?

As the world is becoming more and more digital, I believe that Product Designers have a head start. We understand the human aspect, and are not afraid for questioning status quo, but in contrast to other design professions we still have tangibility in the back of our heads. As technology has gotten cheaper, smaller and more accessible we can now prototype the experience in a way that previously was not possible. What I think technology such as haptic feedback enables, is an extension of human touch. The reason why I did not only do an smartphone application, is because it is lacking real world connection. Without a tangible element, I feel that we are limiting our natural senses and become more disconnected from the world. Through using technology as the extension, we could hopefully move people on a deeper level. From a behavioral point of view, I think this is absolutely necessary for change to happen. Looking in rear-view on the project, I think music is a great tool to find the right intensity, but it is not optimal for every exercise or pace. Also, earplugs or headphones are not something you would wear for 10 weeks, and this for me is making a huge difference. You don’t just sign up for the Momentum device because you have to, you sign up because you are willing to make lifestyle changes. Seen in a bigger picture, I think that this solution was a step in the right direction - human interaction can of course never be replaced, but it can definitely be extended.
Concept refinement (prototyping) 2 weeks

Final conc. 2 weeks

Final sketches 2 weeks

CAD 3 weeks

Renderings 0.5 weeks

1:1 Model 0.5 weeks

Visualisation material (movie, presentations, poster) 3 weeks

Report hand-in & exhibition 3 weeks+
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APPENDICES
Roger, 59
Congenital heart condition / arrhythmia

A LOWER RISK OF HAVING SERIOUS COMPLICATIONS

Roger was born with a congenital heart condition, there was something wrong with one of the heart valves: it didn’t want to close properly. But at the time, the doctor said that he would “grow out” of it. It wasn’t until he was older and started to row on elite level, that he noticed that something was wrong; “When I started a workout session I had to be careful, otherwise I could just blackout, then I thought, ‘woah, I am not fainting but it’s like having a grey veil in front of your eyes’ … that was just when starting the session, but if I passed that point there was no problem.” He also noticed that his pulse was way higher than that of his friends; “I have had relatively high pulse; a pulse rate of 205 when others had 180.” But he continued on with his life and there was never really a problem, until one day recently when he came back from a workout session. He was sitting down, enjoying a glass of wine when he felt an unpleasant feeling in his chest, like the heart was bouncing around. He went to bed and woke up in the middle of the night to notice that the feeling was still there. That’s when he went to the hospital to check it up. He was then diagnosed with arrhythmia and got medication and a cardioversion - a smaller electric shock that is “rebooting” the heart. After that he felt fine. When we discussed what actually caused the arrhythmia he mentions one thing in particular; “I am generally drinking, or have been drinking a lot of coffee. An extreme amount of Espresso … It has been around 15-20 cups a day.” He has lowered his coffee consumption to about half, but is still not really worried about his condition; “The doctors at the hospital say that my problem is not of the character that the heart will fail or that the arteries will clog up, it is more of an uncomfortable feeling - without the more serious complications. That feels quite safe in my opinion.” But even though the complications might not be fatal, there is still an unpleasant feeling. He says that he is not that happy about how the doctors has treated his case, basically putting him on medication and telling him not to worry. When he is working out he sometimes get arrhythmia, and then he just have to go home again; “If I compare to when I was more active with my workout, I had less problems than I do now.” Today he is therefore using a blood pressure measuring unit to be able to discuss medications and other issues with his doctor.
“The doctors at the hospital say that my problem is not of the character that the heart will fail or that the arteries will clog up, it is more of an uncomfortable feeling.”

-Roger
Anton, 23
Chronic high blood pressure (hypertension)

IN THE RISK ZONE OF HAVING A STROKE

Anton is originally from Stockholm, and this is also where he got his diagnosis. He did elite running - 1500 hurdles - but sometimes fainted and got a massive headache just after running, he went to the doctor to check his values; “We came to the conclusions that I had high blood pressure, and especially during activity it was rising really, really fast.” His problem was mainly that the doctors could not find out what was wrong with him, therefore they treated the symptoms with medication, as standard procedure; “The problem was that I was within a certain risk zones for having a stroke when I had such a headache, so then I had to workout less, but at the time I also had to try out medication and what dose I needed to make the pressure drop.” It took some 6 months to find the right medication, and during this time it was quite tough. At the same time his doctors wanted him quit his elite career; “They recommended that maybe I should stop running like that, but for me that wasn’t really an option for me who were working out and competing on that level. ’I don’t want to quite, I rather treat it and try to find a solution instead’.” He also was not really pleased with how his heart center handled the situation; In Stockholm they were very quick to say that ‘we can’t find anything better, here’s your medication, eat it for the rest of your life’ basically. They couldn’t find the reason and then they just quit.” Today he feels fine, mainly due to the fact that he moved to Umeå and got a different doctor that tried to give him a proper diagnosis, but still he haven’t found out what is causing the high blood pressure. His current diagnosis is ‘chronic high blood pressure’, and today he does other type of workouts because of a leg injury that he had. He thinks that what he was offered as a patient is not enough, that the treatment should be more tailored to his needs and not the other way around.
“when I was working out and ran a lot, it was quite important to have a blood pressure measuring unit, just to see that the levels were good.”

-Anton, about the risk of having a stroke
ROGER - JOURNEY MAP
"It is also good for myself as well. Sometimes it feels like the pulse is racing and it has been more on a more frequent basis recently."

"I haven’t primarily worked out because of my condition, partly because it is fun, but you also feel better, mentally you feel better."
RICHARD - JOURNEY MAP

RICHARD - ISCHEMIC HEART DISEASE (HEART ATTACK)

PHYSICAL EVIDENCE

AT HOME (SUNDAY)

CARDIAC HEREDITY
LIFESTYLE HABITS
STRESS

WHEN HE FELT PREP
PRESSURE

TELLS HIS WIFE TO CALL AN AMBULANCE

IN AMBULANCE

AMBULANCE ARRIVES AFTER 10 MIN.

PRE-MEDICATION STARTS

SPACIALIST DOCTOR

CONTACTS SPECIALIST DOCTOR

X-RAY TO DETECT CLUT

STENT OPERATION

BALDWIN DILATION

INJECTS FLUID

AMOUNT ARRIVES AFTER 2 MIN.

PRE-HOSPITAL CARE

EXAMINATION

SURGERY

AFTER-SURGERY PREPARATION

RECOVERY 4-6 DAYS

AT ICU

HOSPITALIZED

SURGERY (SUNDAY EVENING)

AT HOSPITAL

PIT EMERGENCY

PARAMEDIC

NURSE

SURGEON

140
"I haven't had the same doctor, but I've had my cardiac nurse who has been there for me all the time."

"Do what is simple. It should feel natural, it shouldn't be like earlier when I have been running, where I have been like, "sigh" I have to run faster and faster. Which means that after a week when I have reached my pain threshold, now it isn't funny anymore, and then you stop. You shouldn't build those barriers, but rather find ways that make it simple and fun."
HJÄRTCENTRUM - JOURNEY MAP

HJÄRTCENTRUM - INTERVENTIONAL STEPS

Physical Evidence
- Hip study
- Diagnosis
- At the hospital

Patient Actions
- Doctor
- Nurse
- Physician
- Patient

Interventional Steps
- High blood pressure
- High cholesterol levels
- Bad diet
- Inactivity
- Increased physical activity
- Diet
- Medication
- Stop smoking
- Examination/screening
- Treating symptoms
- 14 day follow up

Interventional Steps
- Lifetime treatment
- More information
- Help to start making it a habit
- I have a cardiac history - why do I have this?
- I don’t want to feel like I am sick
- I already have a workout habit
- What is most important to change?

Interventional Steps
- Education/Group sessions
- Workouts - 1, 2, 3
- Swimming
- Gymnastics
- Goes back to old habits

Support Processes
- Need for support

Need for support
- We don’t want to keep you longer than necessary, might end up only day stay at the hospital, need help to transfer it something regular.

- Maria, Head of Department at Hjärtcentrum

- We don’t want to keep you longer than necessary, might end up only day stay at the hospital, need help to transfer it something regular.

- Maria, Head of Department at Hjärtcentrum

- Then there are few patients who have zero previous experience, saying ‘I know I should but what should I do? Where should I start?’

- Maria, Head of Department at Hjärtcentrum

- ‘The idea is that if you give a more visual response to the patient, then the tendency to make lifestyle changes might increase.’

- Maria, Head of Department at Hjärtcentrum

- ‘I can imagine that a “wake-up call” is something that you more likely experience after diagnosis.’

- Maria, Head of Department at Hjärtcentrum
“Maybe they are fit enough to go back to work, but to go from there to what we offer in the form of monitoring, education and physical training, it may not be as easy to make it work all the time.”

– Mario, Head of Department at NIGHTCARE
BEETENDEMEDICIN - JOURNEY MAP

BEETENDEMEDICIN - INTERVENTIONAL STEPS

1. PHYSICAL EVIDENCE
   - REMINISCENCE
   - AT THE CENTRE
   - MEASURING INITIAL VALUES
   - INTENSIVE WEEK
   - PHYSICAL ACTIVITY
   - DIET
   - LIFESTYLE/STRESS

2. PHYSICAL EVIDENCE
   - HIGH BLOOD PRESSURE
   - HIGH CHOLESTEROL LEVELS
   - OBESITY: IF HAVING A BMI OVER 30, OTHERWISE YOU ALSO NEED HIGH B.P. OR H.C.
   - CAN'T JOIN DUE TO LOSS OF INCOME
   - FIT
   - DON'T FIT

3. SUPPORT SYSTEM
   - EXAMINATION
   - SCREENING

4. LEGEND
   - DOCTOR, NURSE, DIETICIAN
   - TEAM
   - PHYSIOTHERAPIST
   - DIETICIAN
   - PSYCHOLOGIST

If you've had a heart attack, you have become greatly frightened. But it could just as well be... If continue in this direction you might suffer from cardiovascular disease.

Elie, psychologist at Beetendozentrum

"Then we have these sessions on a continuous basis, all patients have the opportunity to continue, some like it and some don't. Some can not fit it into their working life.'

Elie, psychologist at Beetendozentrum

"Because the training is often easier to change, mainly in moving more, so it may well be one thing that brings with it the other things."

Elie, psychologist at Beetendozentrum

"Following a diet is difficult... because we have so many different things that influence our eating."

Elie, psychologist at Beetendozentrum
It is important that our guidelines are fairly easy to live by, it’s not a bootcamp, it is a normalization program.

- Elm, psychologist at Betesdae Centrum

“Accepting that challenge to actually turn off the phone on a regular basis, I don’t need to be updated on Facebook...that you can see those boundaries that ‘now it is right, now I turn off. One should not be reachable in this way.’

- Elm, psychologist at Betesdae Centrum

“Some do write at all, it is too tricky, because it feels too much like if you are at school. How to to get people to continue writing and making use of what they learnt at home? You lose them when they leave for home.”

- Elm, psychologist at Betesdae Centrum
GUNNAR - JOURNEY MAP

GUNNAR - ISCHEMIC HEART DISEASE (HEART ATTACK)

AT SUMMER COTTAGE

PHYSICAL EVIDENCE

CARDIAH HERITAGE

LOW BLOOD PRESSURE & STRESS

HEART ATTACK

HOSPITALIZED

AT HOSPITAL

DOCTOR

PARAMEDIC

CARDIOLOGIST

AT HOME

DOCTOR

DOCTOR

DOCTOR

PHYSIOTHERAPIST

SICK LEAVE (3-4 MONTHS)

STARTS EXERCISING

GETS TOLD FROM ABD. PARTNER MARRIAGE

BACKSIDE CONTACT PERSON

AMBULANCE

ICU

ALREADY LOW BLOOD PRESSURE

LIFESTYLE ADVICES

LOW ENERGY

INVITATION TO "HEART GYMNASTICS"

INFORMATION ABOUT HEART ATTACK IS BAD

BALOON DILATION (SAME DAY)

BROKEN CORDA AT LEFT ATRIUM

MEDICATION DUE TO SIDE EFFECTS

BLOOD THINNING & R. P. LOWERING

NURSE RECOMMENDS SPECIFIC DOCTORS

PRE-HOSPITAL CARE

SURGERY

RECOVERY TIME

PATIENT RECOVERY TREATMENT

"I checked my blood pressure in the morning, evening and after exercise before I cut down on my medication, mainly to have support in the discussion with the doctor."

"The material I have received in a bit light-hearted, like the brochures you get from political parties before the election."

"I told myself that I needed to start very gently."
"What could be done better is the continuing with the doctors, I know I had at least 25 doctors and it was probably up in somewhere between 25-30 doctors."

"It's a pity that they procure the cheapest range of medicine. This means that there is always new drugs with new forms and new names in different sizes and colors, the red becomes white and white becomes red when you get a new set."
LARS - JOURNEY MAP

LARS - ISCHEMIC HEART DISEASE (SILENT HEART ATTACK)

PHYSICAL EVIDENCE

WEEDEND TRIP W. WIFE
CHEST PAIN - NO ACTION
NEW HOME SURF TO PAIN
CALLED A DOCTOR AT HEART-ICU
“CHECK IT UP”
HOSPITALIZED
SICK LEAVE - 1 MONTH
BREATHELLSINGE WHEN TAKING STAINS
PAINTED IN A SMALL ROOM AT HOSPITAL

PATIENT ACTIONS

DOCTOR
SPECIALIST DOCTOR
BALDIN DIATION
X-RAY
SALINE INJECTION TO ENSURE IT’S WHOLE
STENT
BLOOD THINING MEDICATION

“I thought that was great, especially this with being able to register your physical activity,” regarding support from an app.

SUPPORT

ADVICE FROM PROFESSIONAL
EXAMINATION
AFTER-SURGERY PROCEDURE
PATIENT RECOVERY TREATMENT

CONTACT PERSON

DOKTOR
NURSE
SURGEON

ON-SITE EXAMINATION
JOINER TO MEDICATION APP
LIMITED TIME AND ONLY ONCE MED.
EDUCATION DELAYED DUE TO SURGERY.
After talking to both experts and patients the interviews were mapped in so called "journey mappings" - a rough overview of the events mapped out on a timeline. Even though the progression of a heart disease is very different from case to case, there are clearly some insights in the recovery process that are similar. These findings concern first and foremost motivation, hospital-based group activity, treatment, support and barriers that the patient might have during rehabilitation.

1. Motivation for recovery is either obtained through insights about the disease (e.g. during examination or screening) or after cardiac event such as an infarction

2. There are few alternatives to hospital-based exercise. This can be problematic if e.g. living far outside a city or having difficulties joining for other reasons.

3. Treatment and rehabilitation should be more tailored to the needs and conditions of the patient

4. Support from doctors, nurses, psychologists, physiotherapists, dietician is very important for patient recovery.

5. Support from family, friends and colleagues is important for patient recovery.

6. Educational, physical-, mental barriers can curb rehabilitation.
SUMMARY OF PERSONAS

Richard remembered that he had very bad lifestyle habits six months before the event. Having a stressful situation at work together with the lack of routine was the main cause of his infarction. His main painpoints was the fact that he didn’t have very good continuity with doctors, together with not having the motivation for keeping up his exercise. Richard declined participating in the hospital-based exercise due to the fact that it didn’t fit him; he felt too young in comparison to the group. All he received was his target heart rate, but no tools helping him to reach it and keep it.

Richard

“I worked 60-70 hours a week, I had really bad eating habits; sometimes McDonalds 2-3 times a week.”

Gunnar had very bad luck during his rehabilitation treatment. Due to a quite severe event, he had to change doctors 25-30 times and he did not receive information that felt relevant to him, it was “light hearted”. Gunnars main painpoints was the fact that he had a hard time recovering from the event, both physically and mentally. Besides having a history of low blood pressure which made exercising difficult, he had complications during surgery and the medication made him even more tired. This resulted in him declining to participate in hospital-based exercise.

Gunnar

“I told myself that I needed to start very gently.”
Gunnar

“I told myself that I needed to start very gently.”

Lars

“(I) have been a bit privileged in that way... It could have been somewhere else.”

(About working at the hospital)

Lars had the luck of being employed at the University hospital in Umeå while he had his event. After two surgeries he got an infection which pushed his recovery even further. During the process he got taken good care of by the hospital staff, and in the rehabilitation stage he participated in the hospital-based exercise. Lars main painpoints was the fact that he needed to improve his routines, he did not get any post-surgery advices or a risk assessment for a relapse. He also would have needed more information about the side effects of medication; he got to evaluate a rehabilitation app provided by a medical company, which he really enjoyed. Unfortunately this was just a study.

Gunnar had very bad luck during his event. Besides having a quite severe event, he had to change doctors 25-30 times which made it difficult to receive information that felt relevant to him. In his own words - “light hearted”. Gunnar’s main painpoint was the fact that he had a hard time recovering from the event, both physically and mentally. Besides having low blood pressure which made exercising difficult, he had complications during surgery and the medication made him even more tired. This resulted in him declining to participate in hospital-based exercise - for many reasons. Gunnar received his target heart rate, but no tools to help him reach it and keep it.
GUNNAR - JOURNEY MAP, SECOND VERSION
"The material I have received is a bit light-hearted, like the brochures you get from political parties before the election."

"What could be done better is the continuity with the doctors. I know I had at least 25 doctors and it was probably up to somewhere between 25-30 doctors."

"I told myself that I needed to start very gently."
LARS - JOURNEY MAP, SECOND VERSION
Richard - Journey Map, Second Version

Richard

PRE-EVENT

- Medical History
- At Work

EVENT/TREATMENT

- At Home after a shorter walk
- Surgery

POST-EVENT

- In Hospital 4-5 days

PATIENT ACTIONS

- Stress + work + bad habits
- Acute heart attack

VINTAGE CONTACT PERSON

- Paramedic
- Doctor
- Doctor/Nurse

BACKSTAGE EVENTS

- Cardiac history
- Lack of routine

EXAMINATION AND DIAGNOSIS IN CAR

- Balloon dilation (same day)
- Stent

MEDITATION DUE TO SIDE EFFECTS

Stressful, I worked 80 times a week. I had really bad eating habits. Sometimes McDonalds 2-3 a week."

- Information and brochures at site

"It can of course depend on bad lifestyle habits and such, but for me a lot of the problems are genetical."

"It was stressful, I worked 80 times a week. I had really bad eating habits. Sometimes McDonalds 2-3 times a week."
POSSIBLE INTERVENTION POINTS

PHYSICAL DECLINE OVER TIME

DISEASE BUILDUP

FIRST NOTICED CONNECTIONS BETWEEN RISK FACTORS

DIAGNOSIS

VHU

0 10 20 30 40

(INFANT) (CHILD) (TEENAGER) (YOUNG ADULT)
RISK RAPIDLY INCREASES AFTER THE AGE OF 60

INTERVENING GETS MORE DIFFICULT AFTER 60

(SENIOR)
INTERVENTION FOCUS

(SECONDARY FOCUS)

PRIMARY PREVENTION

(Protocol: before harm exists)

SECONDARY PREVENTION

(PRIMARY FOCUS)

CARDIAC EVENT

LIMIT POTENTIAL FROM FURTHER HARM

(Protocol: once harm exists)

(harm continuum)
TERTIARY PREVENTION
(harm entrenched)

SECONDARY PREVENTION
(once harm exists)

TREAT THOSE AFFECTED BY HARM

ANOTHER CARDIAC EVENT

FROM FURTHER HARM

TERTIARY PREVENTION
11 sacrificial concepts based on 13 How Might We questions were presented to physiotherapist Cras Segerbrandt. Cras Segerbrandt told me that she was more in favour of the carrot than the whip - the concepts that were supportive instead of blaming; “I am not a big fan of that method, I believe more in information, knowledge and motivation.” she says. In the end she chose three concept directions that should inspire to the final solution.
THE SOLUTION SHOULD BE...

...CHALLENGING

A solution that is challenging lets the patient explore their boundaries through e.g. gamification. This could in turn spark a longterm interest and generate a better recovery process.

...EDUCATIVE

A solution that is educative makes the patient more aware about the disease and possible symptoms and side-effects such as e.g. complications after surgery, medication and lack of sleep.

...TAILORED

A solution that is tailored is more adapted to the patients needs and limits. It could for example be building on the already existing sport that the patient enjoys or let them have a more continuous contact with doctor or nurse.
The concept directions chosen by Cras Segerbrandt where merged into three new concepts targeting the needs of the personas. These concepts where then turned into mock-ups that are using three different technologies, one being invasive, one being semi-invasive and one being non-invasive. The concepts also had three different approaches to cost and where to be worn, focusing on the senses of sight-, audio- and touch-feedback.
The three mock-up concepts were then categorised into different levels of implementation; how close or far into the future can these three be implemented? Concept 1 and 2 could very well be implemented right away or within a year, where Concept 3 is more likely to be implemented earliest in 10 years, maybe even longer.
Concept 1 is a more personalised but inexpensive way of showing information in a more elegant and professional way than today. Since cardiovascular diseases normally is something you live with all your life, the treatment is more closely related to a chronic disease in terms of treatment. The information, being an updated version of the existing binder used at Beteendecentrum in Umeå, is containing tailored advices in paperform as well as a wearable that is translating pulse rate into Borg-scale-RPE. The idea is that the watch is programmed at the hospital/rehabilitation centre before starting, perhaps during the submaximal test where you establish the patients physical capacity. Through using the Borg-scale-RPE patients can keep just at the right level of exertion.

Concept 2 is a first aid kit-like container that could be brought both at work or when travelling. Instead of keeping folders and brochures separately, the kit would contain all the information needed during recovery. Information would come in paperform as a “handbook” where the patient could look up necessary information like a small encyclopedia, rather than getting very general information that is not targeting anyone. A pair of earbuds containing PPG-technology would give the patient audio-based pacing support throughout the exercise. The inside of the packaging container also contain a downloadable app (QR code) that could be used by friends and family to actively engage in the physical activity exercises.

Concept 3 is a so called “smart stent” - an upgrade of the existing stent used during PCI-surgery - that would be inserted into the patient and then powered by a Radio Frequency transmitter attached to the body. In turn, the transmitter would be connected through a smartphone where settings could be made by both the patient and the doctor/nurse. The idea is that the smart stent would measure important values in the body and translate it to useful information during rehabilitation. The information that would go along with the transmitter would be limited, instead lifestyleadvices on what to focus on would be presented
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